

SEFARI



Identifying research priorities for the use of agri-tech to improve productivity, efficiency and sustainability in beef and sheep livestock production systems in Scotland.

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EXECUTIVE SUMMARY

The aim of this SEFARI Spark/Think Tank project, designed to scope current topical issues, was to identify research priority areas for agri-tech use in beef and sheep livestock production systems, where uptake is currently limited. A survey was developed to capture this information, and was distributed between June and August 2020. Opinions on limitations and barriers to uptake were collected. In total, there were 71 responses from a range of respondents including farmers, crofters, consultants, farm advisors, veterinarians and academics/researchers. A follow-on virtual workshop was hosted to discuss views on priority areas and barriers to uptake.

Many respondents to the survey had prior experience with the use of agri-tech, mainly its use for liveweight and growth in beef systems and electronic animal identification in sheep systems. The cost of systems was the main barrier to uptake in both beef and sheep systems, however, this is possibly coupled with a lack of understanding of the potential return of investment. Other limitations/barriers included internet connectivity requirements in remote regions, and not understanding the benefits or how to fully use the system.

Animal health was identified as the main research priority area for both beef and sheep production systems. However, further work is needed to identify exactly which health issues require investigation. Other priority areas identified included liveweight and growth, nutrition, electronic identification (EID) for management (sheep) and fertility/oestrus (beef). It was clear from the survey responses and the subsequent workshop that there are often too many data streams and a single system that integrates outputs into a simple format is lacking.

INTRODUCTION

This think tank/spark project was funded through the Scottish Environment, Food and Agriculture Research Institutes (SEFARI) Gateway. The Think Tank mechanism is designed to provide a new capability by drawing on the breadth and depth of disciplinary expertise within SEFARI to allow for the opportunity to respond to national and global grand challenges - to deliver insight and vision addressing challenging and often contested research questions of national and international importance. The project team consisted of members of staff from SRUC and the Moredun Research Institute, with Agri-Epi Centre as co-project lead stakeholder.

Livestock farming systems form a major part of Scottish food production. These systems are facing increasing pressure to produce meat in a more environmentally sustainable way, with high standards of animal welfare and decreased reliance on antimicrobial and antiparasitic usage (due to the increasing risk of resistance). There are considerable inefficiencies within the beef and sheep sectors with small increases in efficiency having a marked effect on profitability due to current low profit margins. Poor animal health can lead to loss of productivity, with reductions in efficiency often observed before the appearance of clinical signs of ill health. It is difficult for farmers to measure performance, efficiency and welfare of individual animals. Agri-tech, the use of technology to improve efficiency and, hence, profitability, has allowed for continuous and automatic monitoring of production parameters, environmental impact, animal health and welfare at the individual animal level. Agri-tech is the use of technology in farming, such as EID tags and readers, weigh crates and platforms, feed monitoring systems and animal mounted sensors (accelerometers). For example, increased monitoring of animals through animal-mounted sensors, which detect changes in activity levels, allows for poorly performing animals to be identified sooner. The potential benefits associated with the use of agri-tech in beef and sheep production systems are far-reaching. This includes improved animal health and welfare, reduction in the use of veterinary medicines, reduced treatment costs, reduced labour requirements, increased productivity, and product quality, all with a lower environmental impact.

The aims of this project were to identify research priority areas for the use of agri-tech to improve productivity, efficiency and sustainability in two livestock sectors where the uptake of agri-tech is still limited in Scotland i.e. beef and sheep production systems. This was carried out through use of an online survey and follow-up workshop, driven by participants from the beef and sheep industry to understand where the gaps exist and current limitations.

SURVEY OBJECTIVES, METHODOLOGY AND DATA COLLECTED

An online survey (Google Forms) was created and circulated to a range of key stakeholders in the beef and sheep sector (farmers, crofters, consultants/advisors, veterinarians, academic/research etc.). The survey was circulated through SRUC's, The Moredun Research Institute's, Agri-Epi Centre's and SEFARI's combined network of relevant contacts, along with coverage in regional news. The survey was open to responses between 20 June 2020 and 31st August 2020 and was fully approved by SRUC's Social Science Ethics Committee prior to circulation. Data collected in this survey included basic demographic information (e.g. geographical location, age, occupation), main farming enterprise, current experience with agri-tech use, limitations and barriers to technologies, and ranking the importance of areas that should be prioritised. A copy of the circulated survey form can be found in Appendix 1.

SURVEY RESULTS

In total there were 72 responses to the survey, one response was removed due to it being a duplicate respondent.

Job Description

Of the 71 responses, 65% were farmers/crofters, 27% consultants/farm advisors, 4% academics/researchers, 1% vets, 3% others, including agri-tech centre and suppliers of agricultural goods.

Location

Ninety-two per cent of respondents were from Scotland, including Aberdeen and Grampian (20%), Perthshire (14%), Borders (13%), Dumfries and Galloway (13%), Highlands (13%), Argyll (6%), Glasgow and Clyde Valley (6%), Ayrshire (3%), Angus and Dundee (1%), Hebrides (1%), Orkney (1%) and Stirling and the Trossachs (1%; Figure 1). Four per cent of respondents did not provide a location and 4% responded from outside Scotland (including Wales, England).

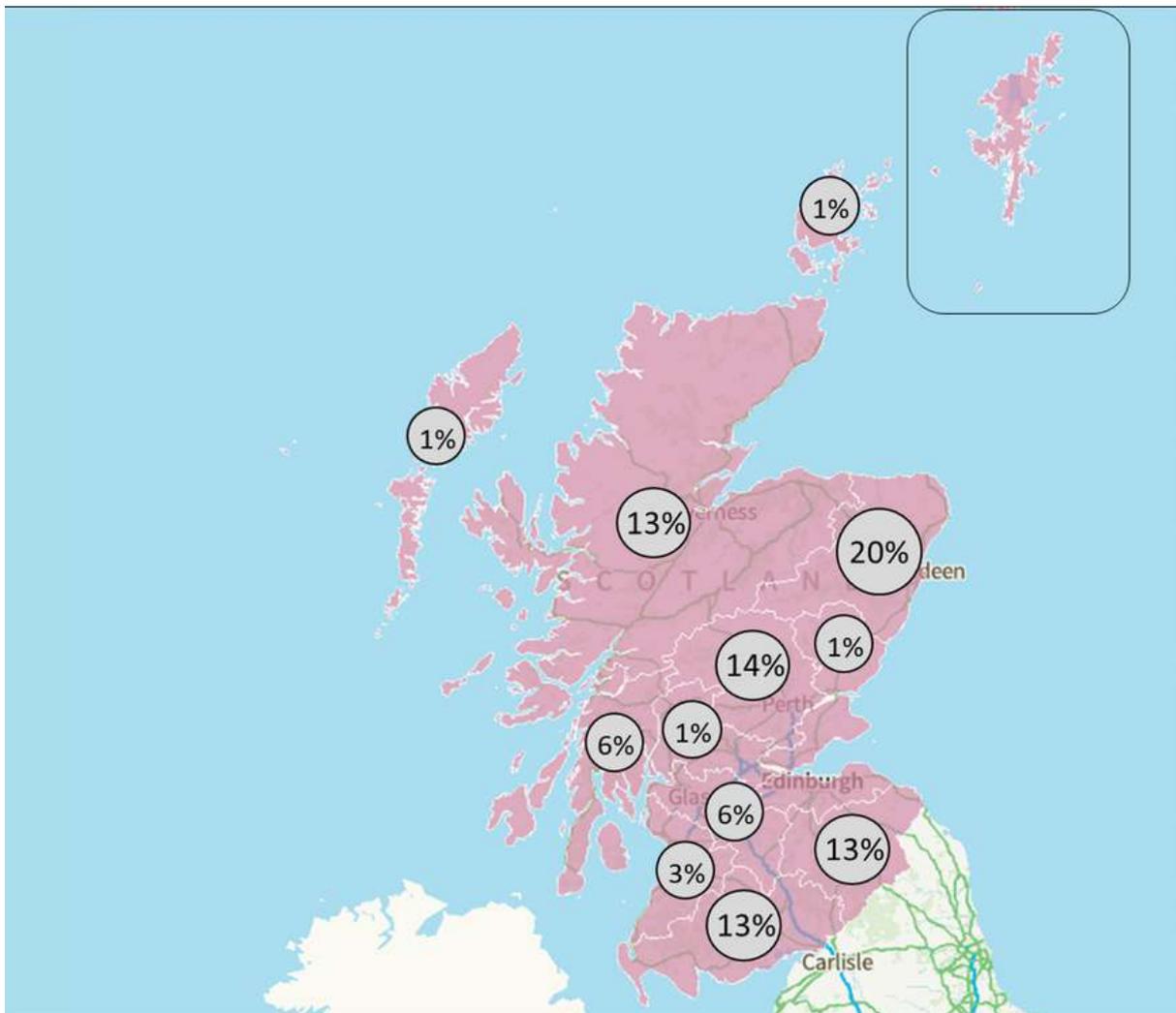


Figure 1. Geographical location of respondents to survey. Map edited from visitscotland.com

Age

The majority of respondents (47%) fell into the 35-54 age bracket, 32% of respondents were aged 18-34, 20% ages between 55-74 and 1% aged 75 or older.

Main Farming Enterprise

Beef was identified as the primary enterprise for 34 respondents (48%), with a further 23 (32%) having sheep as secondary enterprise. Sheep was the main enterprise for 33 (46%) respondents with 13 (18%) respondents also having beef as a secondary enterprise. Four respondents did not provide an answer, however, these were consultants/farm advisors. A summary of this can be found in Table 1.

Table 1. Summary of primary and secondary enterprises of respondents.

Primary Enterprise	Responses	Secondary Enterprise	Responses
Beef	34	Sheep	23
Sheep	33	Beef	13

Farming Organisations

Survey participants were members of several farming organisations including National Farmers Union and National Farmers Union Scotland (NFU/NFUS; 32%), National Sheep Association (7%), Scottish Beef Association (3%), various breed societies (3%), Scottish Crofting Federation (3%), The Moredun Foundation (3%), Soil Association (1%), Quality Meat Scotland (1%), SAC health scheme (1%) and Institute of Auctioneers and Appraisers in Scotland (1%).

Current Agri-tech Use

Survey respondents were asked to identify in which areas they had used technology to remotely monitor animals. Technologies associated with liveweight and growth had the largest number of responses from beef enterprises (26), followed by calving (19), electronic animal identification (18), animal health (15), nutrition (9), fertility/oestrus (7) and rumination (5). A summary of current experience with agri-tech in beef systems can be found in Figure 2. Information on the specific types of disease or animal health detected using agri-tech was not collected in this survey, but warrants further work.

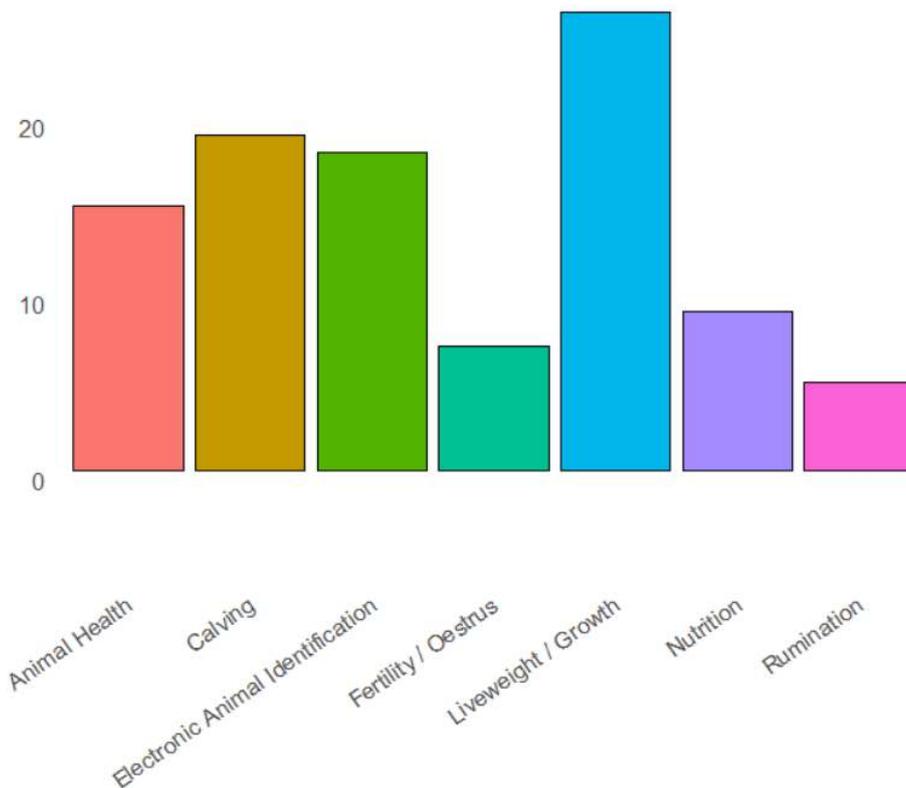


Figure 2. Current experience with agri-tech use in beef production systems

Technologies associated with electronic animal identification had the largest number of responses (35) from respondents in the sheep sector, followed by liveweight and growth (27), animal health (17), reproduction/lambing (14), nutrition (8) and location (6; Figure 3). However, as described above, information on specific types of disease or ill health detected using agri-tech was not collected.

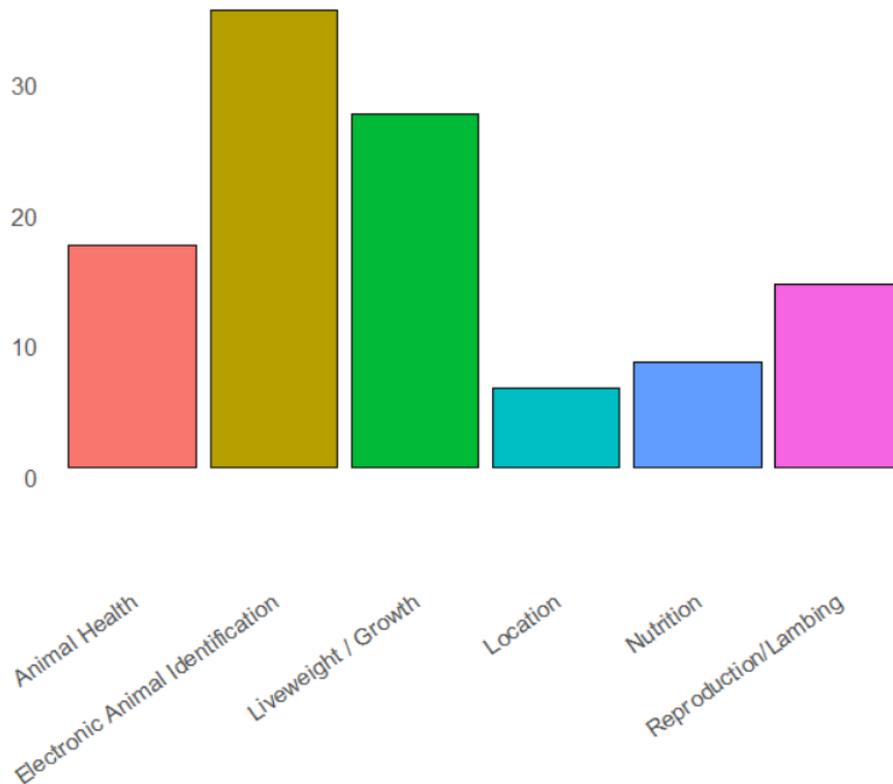


Figure 3. Current experience with agri-tech use in sheep production systems

Limitations and Barriers to Uptake

Several limitations and barriers to uptake were identified, the main one was cost of systems (32 responses for beef; 33 responses for sheep), this was identified as an issue particularly for smaller herd or flock sizes. The need for systems to connect to the internet was also identified as a major limitation (16 beef; 17 sheep), with several respondents noting unreliable internet connections on-farm. Other limitations identified included insufficient training or insufficient understanding of the system (7 beef; 16 sheep), and not understanding the benefits of such systems (11 beef; 15 sheep). One respondent noted that a system which combines outputs from livestock, veterinary medicine usage, maps and farm costings is lacking at present.

Research Priorities

Respondents were asked to rank from a scale (1-7 for beef; 1-6 for sheep) which research area was (1) the most important or (7) the least important. Areas for beef included; animal health, calving, electronic identification (EID)/management,

fertility/oestrus, liveweight and growth, nutrition and rumination. Areas for sheep included animal health, EID for management, location, liveweight and growth, nutrition and reproduction/lambing. Responses to this ranked question were plotted in a colour gradient in which the darkest colour represents the most important area (ranked 1) and lightest colour represents least important area (ranked 6 in beef and 7 in sheep). Top 4 priority areas (from the predetermined list) were noted by ranking top 3 positive responses (see threshold lines in red on Figures 4 and 5).

Within beef systems, animal health, liveweight gain and growth, fertility/oestrus and nutrition were identified as top priority areas for agri-tech deployment and for future research (Figure 4). As noted above, responses on which specific health issues were of greatest interest were not collected (i.e. this was not included in questions to respondents). Technology designed to record and monitor rumination, calving and EID use for management were identified as least important.

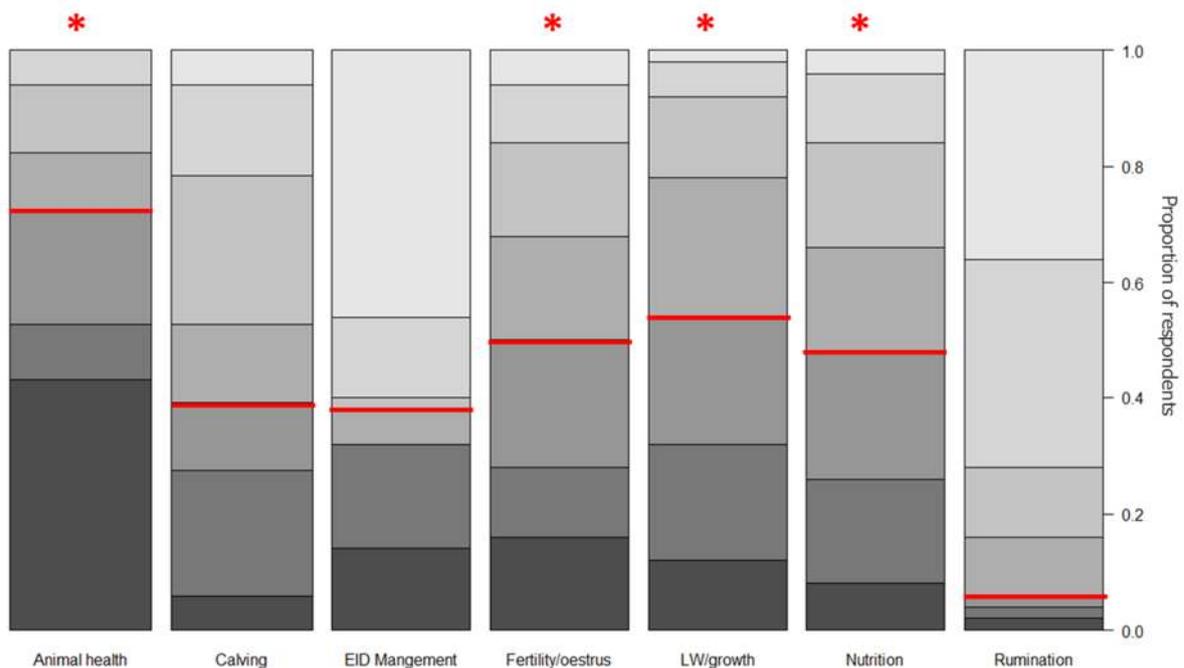


Figure 4. Top research priority areas for agri-tech use in beef systems (top 4 identified with *).

Similarly in sheep systems, animal health, liveweight and growth, EID use for animal management and nutrition were identified as top priority areas (Figure 5). Reproduction and lambing were noted as least important.

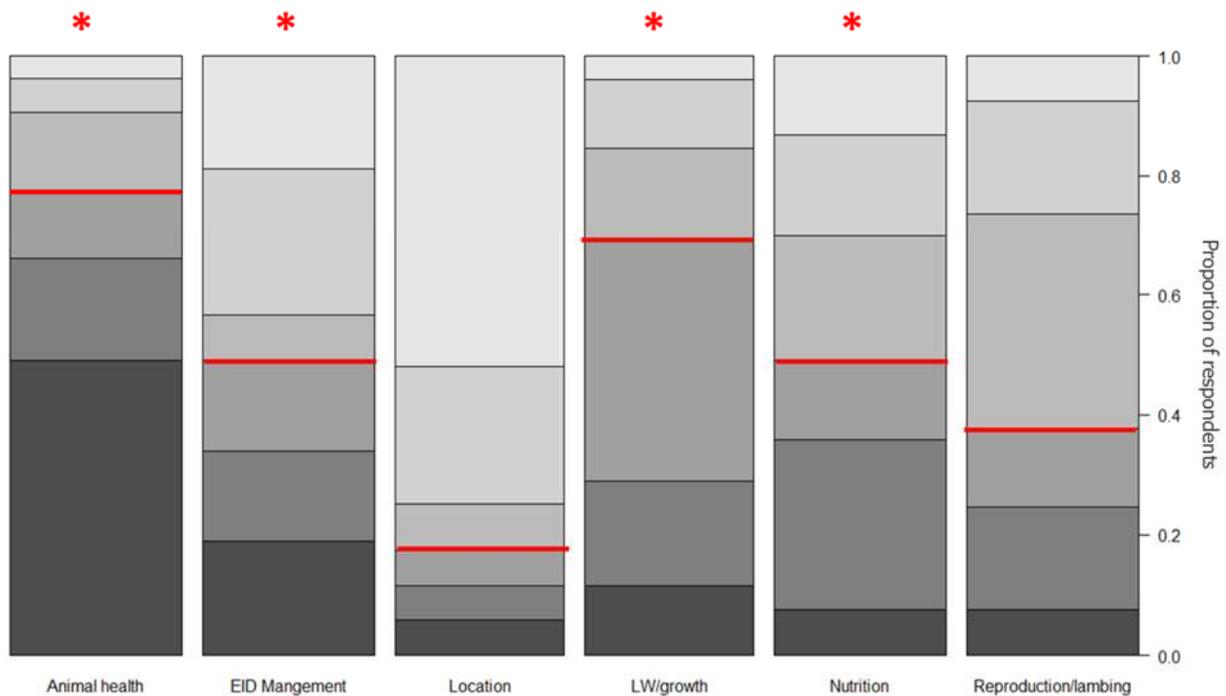


Figure 5. Top research priority areas for agri-tech use in sheep systems (top 4 identified with *).

WORKSHOP AIMS AND OBJECTIVES

The aim of the workshop, held virtually on 10th November 2020, was to further discuss current views/limitations of agri-tech systems and identify which systems or technologies should be developed and research focused on going forward.

The workshop was split into three sections; (i) presentations on current agri-tech usage and overview of survey results, (ii) breakout rooms to facilitate discussions around agri-tech use, limitations and priority areas and (iii) feedback session to main group. There were 12 workshop participants including farmers, consultants, researchers and Scottish Government policy advisors. Participants were split into breakout rooms based roughly on main enterprise or interest (e.g. breakout room A, sheep; breakout room B, beef). Discussions in breakout rooms were focused around three main areas, before being discussed generally within the main workshop room:

- Positives/negatives to current systems
- Barriers to uptake and potential solutions
- What technologies would you like to see developed going forward?

WORKSHOP OUTPUTS

Breakout Room A - Sheep

Technology is driving improvements in rotational grazing. This includes measuring grass with a plate meter, driving efficiency of both land/grass production and animal efficiency, enabling farmers to identify weaker performing fields. Technologies currently in use include:

- Plate meter and normalised difference vegetation index (NDVI) to monitor grass growth and pasture health. Also use of sonar plate meter although not as accurate.
- Use of drones (however, very weather dependent).
- Monitoring of weather and associated disease risk (e.g. parasite forecasting for fluke/worms).

Several limitations and barriers to uptake and potential solutions were discussed:

- The need for systems to connect to the internet. It is often the case that mobile systems/SIM cards are more reliable and faster than landline/broadband.
- Knowledge and confidence in using these technologies in sheep farming is low. Many sheep farmers think it is only breeders that need to use them. Potentially links to not appreciating the full benefits of the systems.
- Having technology solutions on-site but not using, or knowing how to use, each to its full potential.
- More beneficial to have all information in one place, there are currently too many software options and data streams.

Several areas were identified for future agri-tech use, and research and development of systems:

- The sheep industry could make more use of EID for management, tagging an animal just prior to it leaving the farm means you are missing an opportunity to easily capture and use the data for management and to improve efficiencies.

- There is a gap for automatic measurement of condition scoring in sheep flocks. However, it was noted that this is potentially only possible around weaning time when there is less fleece cover.
- The sheep industry has an iceberg of diseases, which are often hard to detect and go unnoticed. In addition, farmers typically carry out limited diagnostic testing. There is potential for more work in this area.
- The quantity of data/available data streams is problematic. User-friendly mobile apps with key messages are required to drive improvements.

Breakout Room A - Beef

Electronic identification is important for management and commonly used in dairy systems, but less so in beef. Often management of beef cattle occurs at the herd level rather than individual animal level. However, it was noted that it is still important to identify top and bottom performing animals. Compulsory EID tagging of cattle is coming into force soon which will help move this forward. There were also questions around who “owns” the data that comes from precision livestock farming (PLF) technologies, the farmers, the agri-tech companies, or a combination?

Several limitations and barriers to uptake and potential solutions were discussed:

- Cost of the system is an issue, especially when farmers may not fully understand the benefits.
- There are often too many data streams and too much data coming from systems. A much more simplified approach is needed.
- The time it takes to set up and troubleshoot problems is also an issue. Farmers want something simple to use that provides accessible outputs.

Several areas were identified for future agri-tech use, and research and development of systems:

- Technologies and systems need to be “future-proofed”, e.g. EUROP grid (carcass classification for fat and conformation) is outdated and new systems

need to be able to predict other carcass parameters that may be used in the future. This could potentially form the basis of a future payment scheme.

- There is potential to link EID technology to health management, e.g. automatic system linking dosing gun to weigh head to provide accurate dosing (unit/kg liveweight) of medications.
- There is appetite to see technologies developed to measure and mitigate greenhouse gas (GHG) emissions. Discussions included reducing days to slaughter and generating carbon credits for farming systems.
- Compulsory tagging of cattle is coming into force shortly, there is potential to use this to improve traceability.
- Data streams need to be integrated and clear outputs provided to help inform decisions to drive efficiency. Farmers “want to spend more time driving tractors and less time driving computers”.

Group Discussion

There was further discussion in the main breakout room about current agri-tech usage across Scotland and barriers to uptake:

- Uptake of technologies is on a spectrum, some farmers have high uptake of agri-tech systems and others no uptake. There are still many farms which exist without basic equipment such as weigh scales. There needs to be a stepped approach to encourage uptake across the board – “entry-level” and “easier access” technologies will still lead to overall gains. Data from these systems will allow farmers to make informed management systems.
- There are issues with uptake caused by farmers not seeing an instant return on investment, i.e. not seeing the financial benefits from installing the system straight away.
- A generational divide may be an issue with technology uptake – younger generations appear keener to invest in technologies. The reasons may include a greater familiarity with smart technology and value of a work/life balance.
- Data needs to be fed back down the supply chain – e.g. currently, there is little to no feedback to breeders on a finishing animal’s performance.

- It is not the data that is the most important aspect, but the outputs and messages provided to farmers. Often important messages are hidden or lost in the vast amounts of data.

RECOMMENDATIONS

- This report highlights areas of priority for agri-tech use in beef and sheep production systems, as well as identifying limitations and barriers to uptake. The main limitations of systems included the cost of systems, however, this is potentially caused by farmers not seeing an instant return on investment or not knowing fully how the systems work. Animal health was identified as the main research priority area for both beef and sheep production systems, but not broken down to priority diseases or syndromes. Other priority areas identified included liveweight and growth, nutrition, EID for management and fertility/oestrus. A major response was that not all data are important for farmer decision making. There is a clear need for integration of data streams to provide simple and clear outputs which can help drive decisions on efficiency. Below we set out recommendations from this think tank: Prioritization of data and integration of agri-tech solutions into future payment schemes to help improve sustainability and efficiencies of production systems.
- Enhanced infrastructure spending in rural areas to improve digital connectivity to allow increased agri-tech adoption.
- Increased knowledge exchange (KE) opportunities demonstrating and showcasing the benefits of agri-tech systems and technological solutions, particularly around the use of “entry-level” technologies and cost benefits of systems.
- Demonstration of increased productivity and decreased GHG emissions associated with agri-tech adoption to help achieve Scotland’s net-zero target by 2045.
- Increased use and visibility of demo/monitor farms showcasing benefits of agri-tech adoption enabling greater farmer-to-farmer learning.
- Increased funding opportunities to develop systems to address priorities identified in this think tank.

Appendix 1. Survey - The Use of Agri-Tech in Beef and Sheep Farming Systems in Scotland

The information collected in this survey will be used to identify key areas for the use of agri-tech to improve productivity, efficiency and sustainability in both beef and sheep production systems in Scotland. Agri-tech is the use of technology in farming, such as Electronic ID tags/readers, weigh crates/platforms, feed monitoring systems, animal mounted sensors, etc. The data will be used as part of a wider project funded by Scottish Environment, Food and Agriculture Research Institutes (SEFARI) to identify research priority areas for the use of agri-tech in Scotland. The project team includes members of staff from SRUC, The Moredun and Agri-Epi Centre. We understand that some information may be confidential, so providing details for each question is optional.

This survey should take no more than 5 minutes to complete and can be completed anonymously. By participating in this survey, you have the option to be entered into a draw for a £30 Amazon gift voucher, participants also have the option to enter this draw without completing all questions in this survey.

Your participation in this study is entirely voluntary and you can withdraw at any time, even after completion. There are no known risks associated with this survey; however, as with any online related activity the risk of a breach is always possible. We will minimize any risks by storing data securely on a remote server with restricted access. No attempt will be made to capture information that is not voluntarily supplied by the respondent. If email addresses are voluntarily provided these will be saved in a separate file away from responses to this survey in such that specific responses cannot be linked back to individuals/email addresses. For further information or queries please contact Jenna Bowen (Jenna.Bowen@sruc.ac.uk)

I agree to participate in this survey

Yes/No

- Please describe your job description from the list below. If selecting other please provide a description.

- Farmer
 - Veterinarian
 - Consultant/Farm advisor
 - Academic/Research
 - Other
 - Prefer to not to say
- In which Scottish region are you based. Please select Other if completing from outside Scotland.
 - Aberdeen and Grampian
 - Angus and Dundee
 - Argyll
 - Ayrshire
 - Dumfries and Galloway
 - Edinburgh and Lothians
 - Fife
 - Glasgow and Clyde Valley
 - Highlands
 - Orkney
 - Hebrides
 - Perthshire
 - Borders
 - Shetland Islands
 - Stirling and The Trossachs

- Other
 - Prefer not to say
- In which age category do you fall?
 - 18-34
 - 35-54
 - 55-74
 - 75 years or older
 - Prefer not to say
- Are you a member of any farming organisations? If you would prefer not to disclose this information please leave the below box empty.
- Please select your main farming enterprise – *note that you have the option to fill out the survey for both beef and sheep enterprises:*
 - Beef
 - Sheep

BEEF

- From the list below, please select the areas where you are, or have used technology to remotely monitor livestock. Tick all that apply and please provide details in the box below.
 - Animal health
 - Nutrition
 - Liveweight/animal growth
 - Fertility/oestrus
 - Calving
 - Rumination

- Electronic animal identification for management
- Other – please state in the box below
- From the list below please select limitations you may have experienced with these technologies. If you have limitations out with this list, please describe in the “other” box.
 - Cost of system
 - Insufficient training/not knowing how to fully use the system
 - Not knowing the benefits of the system
 - Need for systems to connect to internet
 - Other
- On a scale of 1 to 7 please rank the below technologies in order of importance for which research should be prioritised (1 being most important and 7 being least important)
 - Animal health
 - Nutrition
 - Liveweight/animal growth
 - Fertility/oestrus
 - Calving
 - Rumination
 - Electronic animal identification for management
- Do you wish to complete the survey for sheep enterprises? Yes/No

SHEEP

- From the list below, please select the areas where you are, or have used technology to remotely monitor. Tick all that apply and please provide details in the box below
 - Animal health
 - Nutrition
 - Liveweight/animal growth
 - Reproduction/lambing
 - Location
 - Electronic animal identification for management
 - Other – please state

- From the list below please select limitations you may have experienced with these technologies. If you have limitations out with this list, please describe in the other box.
 - Cost of system
 - Insufficient training/not knowing how to fully use the system
 - Not knowing the benefits of the system
 - Need for systems to connect to internet
 - Other

- On a scale of 1 to 6 please rank the below technologies in order of importance for which research should be prioritised (1 being most important and 6 being least)
 - Animal health
 - Nutrition
 - Liveweight/animal growth

- Reproduction/lambing
- Location
- Electronic animal identification for management
- Do you wish to complete the survey for beef enterprises? Yes/No

ALL RESPONDANTS

Thank you for your participation in this survey. We will be holding a workshop in November to further discuss the research priority areas for agri-tech use. If you are willing be contacted in the future about participation in this workshop please tick the box below and provide preferred contact details in the box below.

- Tick box – I am willing to be contacted.

By ticking the below box I agree to the below terms and conditions of entering the draw for a £30 Amazon gift voucher. Leave empty if you do not wish to be entered into the prize draw.

- Tick box – I would like to be entered into the draw.

Name and email address, or preferred contact details (leave empty if you wish to remain anonymous).

T&Cs of prize draw

1. The prize draw is open to all respondents who complete the The Use of Agri-Tech in Beef and Sheep Farming Systems survey.
2. Entry to the prize draw is by completion of The Use of Agri-Tech in Beef and Sheep Farming Systems survey. Note that participants can enter this draw without completing all questions in this survey.

3. Only one entry per person. Multiple entries will be removed.
4. There is 1 prize: £30 Amazon gift voucher
5. The prize draw (and survey) closes at 23.59 on 31st August 2020 [with winners drawn on 7th September 2020 using a computer programme to randomly generate a winner].
6. The winner will be notified by email on 8th September 2020 to the email address they specified when they completed the survey. If the winner does not claim the prize within 30 days of being notified, they will forfeit the prize and a re- draw will take place. To claim the prize the winner must follow the instructions in the email notifying them that they are the winner. The Winner will receive their prize no later than 30 days after they claim the prize.
7. There is no cash alternative to the prize.
8. No responsibility will be accepted for incomplete or lost entries or entries not received.
9. By entering the prize draw you agree to be bound by these terms and conditions.

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